

## What are Medium Chain Triglycerides?

Medium chain triglycerides (MCTs) are naturally occurring fats found in a variety of foods. Consisting of three saturated fatty acids attached to a glycerol backbone, they are 6-12 carbons atoms in length and easily digested. This is in contrast to other types of fats, such as long chain triglycerides, which require passage through the gastrointestinal track to be broken down and delivered to the body as nutrition and energy. MCTs on the other hand are quickly absorbed in the intestines and transported directly to the liver to be utilized for energy (via beta oxidation). Coconut oil, palm kernel oil, and dairy fat (such as butter) are common food sources high in MCTs, but also contain a variety of other fats<sup>1,2,3</sup>. For example, coconut oil contains MCTs along with polyunsaturated fatty acids, monounsaturated fats, and short chain saturated fatty acids.<sup>3</sup> However, naturally distilled oils are available that exclusively contain MCTs, most commonly: lauric acid, caproic acid, caprylic acid, & capric acid.<sup>2</sup>

## Why are MCTs used?

Medium chain triglycerides are used for a variety of reasons, including the following:<sup>2</sup>

- Enhance athletic performance
- Improve body composition (decrease body fat, increase lean muscle mass)
- Promote weight loss
- Treatment of certain digestive disorders including: diarrhea, gallbladder disease, fat indigestion (also known as steatorrhea), celiac disease, liver disease, gastrectomy (partial surgical removal of the stomach), & short bowel syndrome (partial removal of the intestine)
- Alzheimer's disease
- Seizure disorders (specifically in children)
- Lower cholesterol and/or triglycerides (types of fats in the blood)
- Diabetes
- Waldmann disease (a rare disease where there is an enlargement of the lymphatic vessels of the small intestine)
- As a source of fat for individuals receiving nutrition via total parenteral nutrition

## What Does the Science Say?

### *Digestive Issues:*

For those who have difficulty digesting fat, MCTs may be absorbed better than other types of fats in the diet such as long chain triglycerides (LCTs).<sup>4</sup>

According to Natural Medicines Database, MCTs may be effective for treatment of Waldmann disease alongside a low-fat, high protein dietary pattern.<sup>2</sup>

### *Promoting Weight Loss and Altering Body Composition:*

Overall, research is inconclusive regarding the potential benefits MCTs may have on facilitating weight loss. Research has suggested that due to differences in the metabolic effects of MCTs vs. LCTs, substitution of MCTs for LCTs may assist weight loss efforts.<sup>5</sup> Medium chain triglycerides are not as easily stored as LCTs in fat tissue, as they are utilized quickly for energy production. Medium chain triglycerides may increase fat breakdown and increase fat utilization for energy.<sup>2</sup>

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Studies have found that MCT use may promote a more favorable ratio of fat tissue to lean muscle mass. A double-blind controlled trial conducted with healthy men and women found that those with a BMI  $\geq 23$  kg/m<sup>2</sup> lost significantly more body fat when MCTs were consumed versus LCTs.<sup>6</sup> Furthermore, weight loss in the MCT group was significantly greater when compared to the LCT group. The authors concluded that diets higher in MCTs compared to LCTs may reduce body fat and weight in individuals with a BMI  $\geq 23$  kg/m<sup>2</sup>.<sup>6</sup>

Studies have also tested the effects of MCT supplementation while following a very low-calorie diet. A 4-week double-blind, placebo-controlled trial tested the effects of MCT supplementation while subjects (66 obese women) followed a low-calorie diet. There was a control group where 22 subjects were randomly assigned to follow a low fat, low calorie diet, while the remaining subjects followed either a low-calorie diet with MCTs, or a low-calorie diet with LCTs. The MCT group received 9.9g MCTs, while the LCT group received 8.8g LCTs. Results found a significant decrease in body weight after the first two weeks of treatment in the MCT low-calorie diet group. The amount of body fat loss was significantly higher in the MCT group, having the most prominence after 1 week of following the MCT protocol. Individuals in the MCT group also felt less hungry and had higher levels of satiety. The MCT group had higher levels of ketone bodies compared to the LCT group. It is of note that these differences were only found during the first two weeks of treatment, and differences between the groups declined during the third and fourth weeks of the study.<sup>7</sup>

A randomized crossover controlled feeding study conducted with healthy, overweight men analyzed the effects of diets rich in MCTs or LCTs on body composition and energy expenditure. The authors found that those receiving MCTs (using a functional oil composed of 64.7% MCT oil) had a greater decrease in adipose tissue compared to the LCT group. They also found that the MCT group had a greater increase in energy expenditure on day 2 of the study; however, this was not statistically significant by day 28 of the study.<sup>8</sup> The authors concluded that a diet rich in MCTs results in greater loss of fat mass compared to LCTs.<sup>8</sup> Of note, this study had a small number of participants (n=24).

Long-term consumption of MCTs compared to LCTs may result in increased energy expenditure and fat oxidation. In one study (a randomized crossover trial) 17 obese women received MCTs or LCTs (75% of total fat in the LCT group was consumed from beef tallow).<sup>9</sup> The MCT group received 50% of their total fat intake from MCT oil (49% octanoate and 50% decanoate), 10% olive oil, the other 5% consisting of butter, coconut, flaxseed oil. The MCT diet group was found to have increased average energy expenditure and fat oxidation compared to the LCT group.<sup>9</sup> Given that the MCT group also obtained monounsaturated and omega-3 fatty acids, it is difficult to truly assess the effect of the MCTs on energy expenditure and fat oxidation from this study.

There is evidence to suggest MCTs can decrease appetite and result in less energy intake. One study compared the appetite-reducing effects of MCTs versus coconut oil (which contains less MCTs compared to pure MCT oil), along with overall energy consumption.<sup>10</sup> Study participants were fed a breakfast that was either high in MCTs, coconut oil, or a control vegetable oil group. Satiety and appetite were measured. The test breakfast consisted of a 250 mL mango and passionfruit smoothie with either coconut oil (26g), MCT oil (25g consisting of caproic acid 2%, caprylic acid 50-60%, capric acid 30-45%, and lauric acid 3%), or vegetable oil (rapeseed oil, 23g). Three hours after breakfast, the participants were presented with the same sandwiches and were told to eat until they felt comfortably full. Significant differences were found in energy intake and fat consumption throughout the day between the various oil types. The highest energy intake was consumed after the control oil, followed by the coconut oil and MCT oil, respectively. An extra 14g of fat was consumed after breakfast in the control oil group compared to the MCT oil group.

Also, there were significant differences in levels of fullness between the groups. The highest perception of fullness occurred in the MCT oil group compared to the control group and coconut oil groups.<sup>10</sup>

#### *Enhancing Athletic Performance:*

Evidence exists that supports using MCTs during exercise; however, research is currently mixed and there is lack of consensus.

A study conducted with athletes examined the metabolic response to MCTs with or without carbohydrates during prolonged exercise.<sup>11</sup> Eight male trained triathletes or cyclists performed 4 trials of 180 minutes of cycling (at 50% maximal work rate) and drank a bolus of either: A single 214g carbohydrate (CH) solution, or CHO + MCT solution (149g CHO + 29g MCT), or one pure MCT drink (29g in water), or one high CHO + MCT trial (214g CHO + 29g MCT). They drank a bolus of 4mL/kg at the start of exercise and 2 mL/kg every 20 minutes during exercise. The authors concluded that MCTs are oxidized more readily when ingested in combination with CHO, and MCTs can serve as an additional energy source in addition to CHO during physical exercise.<sup>11</sup> Of note, this study utilized an extremely small sample size, which is one study limitation.

A more recent study (2018) in mice found beneficial effects of MCTs during exercise, however, it is unclear how these results may be translated to humans.<sup>12</sup>

Natural Medicines Database concludes that MCTs are possibly ineffective for improving exercise performance.<sup>2</sup> Overall, larger studies are needed to further determine if MCTs are effective in enhancing athletic performance. In summary, MCTs may serve as an energy source during exercise in addition to carbohydrates for quick energy.

#### *Diabetes and Insulin Resistance:*

There is some evidence that MCTs may improve insulin resistance, although recent studies are lacking in this area. A pilot study conducted with overweight subjects who had Type II Diabetes assessed if MCT supplementation could have potential benefits. Forty subjects were recruited and randomized into two groups. One group was provided with 18g MCT oil, while the other group received 18g of corn oil (to be utilized in normal food preparation). Results showed a significant decrease in total body insulin resistance in the MCT group between days 45 and 90.<sup>13</sup>

#### *Seizures:*

According to Natural Medicines Database, MCT supplementation is possibly effective for individuals with seizure disorders. Taking MCTs can reduce seizures in some children.<sup>2</sup>

#### *Other:*

Evidence suggests that MCTs may have favorable effects on metabolism by modulation of the gut microbiome.<sup>14</sup> Recent research has found a profound link between gut health and metabolic diseases. MCTs may improve the intestinal ecosystem and prevent intestinal permeability/endotoxemia.<sup>14</sup> Medium chain triglycerides contain antimicrobial properties, which is one possible mechanism behind MCTs role in promoting a healthy gut.<sup>14</sup>

Medium chain triglycerides may play a therapeutic role in Alzheimer's Disease prevention and treatment, although research is inconclusive at this time. Medium chain triglycerides increase levels of ketones in the

body, which the brain utilizes for energy. Ketone bodies may inhibit beta-amyloid damage in the brain and improve Alzheimer's Disease symptoms.<sup>2</sup>

Medium chain triglycerides may have an anti-inflammatory effect on the body. Animal model studies have suggested MCTs may induce inflammatory mediators in macrophages.<sup>2</sup> Human studies are lacking.

Some studies have found that MCTs may increase cholesterol excretion, which results in lower blood cholesterol levels.<sup>2</sup> These studies have been conducted utilizing animal research, and findings from human studies in this area are inconsistent. Lauric acid may provide a cholesterol-lowering benefit by improving the total cholesterol to HDL ("good cholesterol") ratio.

Supplementing with MCTs may play a role in lowering triglyceride levels, according to Natural Medicines Database.<sup>2</sup>

### **Safety of MCTs**

Evidence shows that MCTs are safe when consumed at up to 50% of dietary fat intake (or about 15% of calories consumed).<sup>15</sup> When ingested as a supplement as part of an overall balanced diet they pose little to no risk from toxicity.<sup>15</sup>

### **Side Effects**

Although uncommon, some individuals may experience gastrointestinal (GI) side effects if consumed on an empty stomach.<sup>2</sup> If this occurs, taking MCTs with food can help prevent GI side effects. It is of note that GI side effects are more common with higher doses of MCTs.

### **Dosing**

According to Consumer Labs, when utilized as an athletic supplement doses around 85mg/day are common.<sup>1</sup>

According to Natural Medicines Database, the following doses have been used based on certain health conditions:<sup>2</sup>

- Obesity: MCTs 1-54 grams per day for 4-16 weeks has been utilized in research studies.
- High triglycerides: 25-30g of an oil containing 13% of MCTs taken daily for 8 weeks has been used in studies.
- Seizures in children: 60% of calories from MCT oil has been used to treat seizures in children.

### **Practical Uses**

Pure medium chain triglycerides can be used in cooking, such as a dressing on salads. They are also found in a variety of supplements. They should not be heated above 150-160 degrees Celsius, as they will oxidize.<sup>16</sup>

### **Summary and Recommendations**

Medium chain triglycerides are generally safe to consume. They are easily digested, absorbed, and transported throughout the body to be utilized for energy compared to other types of fats.<sup>16</sup> They have a low tendency to be stored in adipose tissue and are highly ketogenic.<sup>16</sup>

Some evidence exists to support utilizing MCTs for those with digestive issues (such as fat malabsorption), for their ketogenic properties, as a source of quick energy during exercise, to treat seizure disorders (specifically in children), & individuals with Alzheimer's Disease. Currently the strongest evidence exists to support utilizing MCTs for treatment of Waldmann Disease and seizure disorders in children.<sup>2</sup> The role MCTs may play in lowering cholesterol and/or triglycerides is still unclear.<sup>16</sup> Furthermore, consuming MCTs for weight loss/obesity is not well understood and more studies are currently needed.<sup>16</sup>

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